Available online at www.sciencedirect.com
SciVerse ScienceDirect
Procedia - Social and Behavioral Sciences 76 (2013) 253 – 257
Procedia
Social and Behavioral Sciences

5th International Conference EDU-WORLD 2012 - Education Facing Contemporary World Issues

Psychological aspects of using heuristic intuition in arithmetic problem solving in primary school

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Abstract

In the first part of the paper, the theoretical aspects of heuristic intuition are presented, namely the psychological mechanisms by which this intervenes in the context of solving arithmetic problems. Thus, heuristic intuition by procedural moments is only a resolution sequence and the heuristic phenomena are achieved with the participation of two levels: the conscious and the unconscious in solving some arithmetic problems which raise solving difficulties. The achievement of the informational transfer between the two levels should be interpreted as a sequence of entries and exits of the unconscious to conscious, and vice versa, where the principle of feedback is a first psychic mechanism of the heuristic intuition. Also, the fact that most intuitions are preceded by analogies makes us consider the analogy as another psychological mechanism of using heuristic intuition in solving the problem, because the analogy determines intuition and generates solution in this way. The connection between the reasoning by recurrence and heuristic intuition allows the passage of thinking from individual to general, which is in fact the essence of mathematical creation and another psychological mechanism in solving arithmetic problems. The second part of the paper presents a practical example of using heuristic intuition for an arithmetic problem where we analyze the implications of its mental mechanisms and the way of achieving the resolution process. In this regard, we laid emphasis on the mechanism which was used to pinpoint the contradictions of the problematic situation and which creates conflicts between the requirements of the problem and the real possibilities of the pupil, which are determined by the development of thinking. Without highlighting and without understanding all stages of solving, the student finds a similar pattern in his experience from the past and by analogy with this, he solves the new problem.
The paper ends with some conclusions regarding the modalities of using heuristic intuition, in terms of procedure, in the context of solving arithmetic problems in primary school.

Keywords: heuristic intuition, problem, psychological mechanism, primary school

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doi:10.1016/j.sbspro.2013.04.108

1. Theoretical aspects of heuristic intuition and of the psychic mechanism of its usage to solve arithmetic problems

One of the main works on defining intuition [1] characterizes it as a primary mode of perception that operates in the subconscious.

Intuition is a basic cognitive, way, which creates a relationship between preference and the learning performance and the intuitive responses are achieved with an apparent little effort and without the participation of the conscious mind.

Regarded as a way of action, intuition manifests through the three distinct aspects of its nature: affective, heuristic, and holistic. These aspects of intuition are related to the emotional quality of intuitive decisions which were taken and of the described immediate perspectives.

Next, we are going to approach the heuristic intuition, defined as the ability to conceive a judgment based on a minimum of information and where the intuitive responses are directed towards a simple way of finding a solution within an automatic process.

Heuristic intuition is the result of a process where we find the following four stages: premises, maturation, initiation and verification.

When we approach the moments of heuristic intuition we need to mention the differences between matter and intuition, pointing out that intuition is only a sequence in a problem.

In solving arithmetic problems, the intuitions involved in the findings for establishing the solutions were determined in the unconscious, some being related to the given problem and others in circumstances where the creator's attention and will were not centered on it.

Therefore, we must take into account all moments of some finding, linking intuition with the events that precede and succeed it, carefully analyzing all the conscious and unconscious phases appearing in the representations of the given heuristic problem.

Even if, when solving arithmetic problems, intuitions are determined within the unconscious development stage, however, there are premises for a conscious phase that we highlight under the form of questions.

This is why a question formulated in a wrong way can have an inappropriate heuristic value and in this way, the value of the intuitions must be sought at the level of formulating the conscious question, even if they are determined in the unconscious phase.

Thus, for all the arithmetic problems, starting with an unconscious phase, intuition, may find its solution appealing to some mathematical concepts of a conscious manner.

Many mathematicians, consider intuition [2], as a "guess" that precedes any arithmetic reasoning, namely intuition gives a motivation that has to be verified subsequently.

Thus, heuristic intuition is also based on the sense of anticipation, on some scientific experience of an intuitive nature and the findings cannot be logical arguments.

Heuristic intuition is done with the participation of two levels: the conscious and the unconscious through a permanent mutual informational transfer interpreted as a sequence of inputs and outputs of the unconscious in the conscious, and vice versa, based on the so-called principle of feedback.

This principle comes with a set of specifications on psychological mechanisms of heuristic intuition, which is based on the following assumptions: the high level of generality, the psychic value and the heuristic activity as a particular case of psychic activity.

Some arithmetic problems begin with a conscious phase, after the activity of searching the solution, developed at the level of the conscious mind, all unsolved aspects are transferred to the unconscious which, under psychic automatism continue their search.

In this search, an intense creative activity is needed at the conscious level, based on the desire to solve the problem and to find the appropriate solution.

But for this, the entire creation activity involves an accumulation of information focused on the type of the given problem which was not solved during the conscious phase and which the mind sends to the subconscious for processing.

The psychic mechanism of feedback allows as a continuation of the conscious mind, which only formulates the problem to be solved, that the unconscious should intervene by the psychic automatism and that it should make the informational associations and combinations.

Thus, if the solution is correct, the conscious finishes the transmission of information to the unconscious and the solution of the problem can be considered as a mechanism of closing the informational exchange between the conscious, unconscious and vice versa.

The transfer of the solution from the unconscious into conscious mind is achieved on the continuous cooperation between the two levels, on the transfer of information in both directions and on the analogy with other similar problems.

The finding that the solution to the problem was achieved can only be made by the conscious through review of the problem data at intervals of time, when the conscious may determine the presence of what was missing in previous times and in this case, the conscious closes the circuit.

So, in the case of any solving of an arithmetic problem, the conscious increases, if successful or cancels if unsuccessful, the emotion or feeling of satisfaction.

2. Psychological aspects of using heuristic intuition in solving arithmetic problems in the primary school

To look at the use of heuristic intuition in solving arithmetic, we need to look at the teaching and learning of mathematics in primary school, where the concreteness of thinking is maintained.

As the main method of solving arithmetic problems is the graphic method, in primary school we form a series of motor skills, which largely fall within what we call sensor motor learning.

Thus, in drawing a graphic scheme, the psychological analysis of this process reveals the use of the motor act of handling various instruments and of collecting visual information regarding the drawing.

At the same time, one can find an intellectual component and it will be concretized in the moments of thinking and in the work strategy.

These skills are reduced to a sensory component (perceptual) and to a motor one, whether it is about the drawing up of a graphic scheme or about the execution of a mathematical model.

The starting point in acquiring some practical skill of a motor action in mathematics, is the acquisition by observation of a motor act model, where the sequence of work is accompanied by verbal explanations, detailed on elements or moments and where the young pupil forms an initial image of what has to be executed.

So, after a first cognitive phase of orientation and familiarization of the young pupil with the context in which he must work, in which the action pattern is outlined, there will come an analytical stage, on operations, in which the most complex action is cut up and divided into fractions, usually in component acts.

With the habit formation of graphical representation, a partial automation occurs and then, we deal with the third stage, namely the moment of organization and systematization of parts or details of the action.

At this point, the heuristic intuition intervenes, and it unifies the scattered acts, combines the details in a right way and takes the useful information, achieving the feedback mechanism.

I am going to emphasize these mechanisms, taking a problem (see [3]) as follows:

Problem. A pupil has three times more pigeons than rabbits. How many has he of each, knowing that if he sold two rabbits and bought 4 pigeons, then he would have 4 times more pigeons than rabbits?

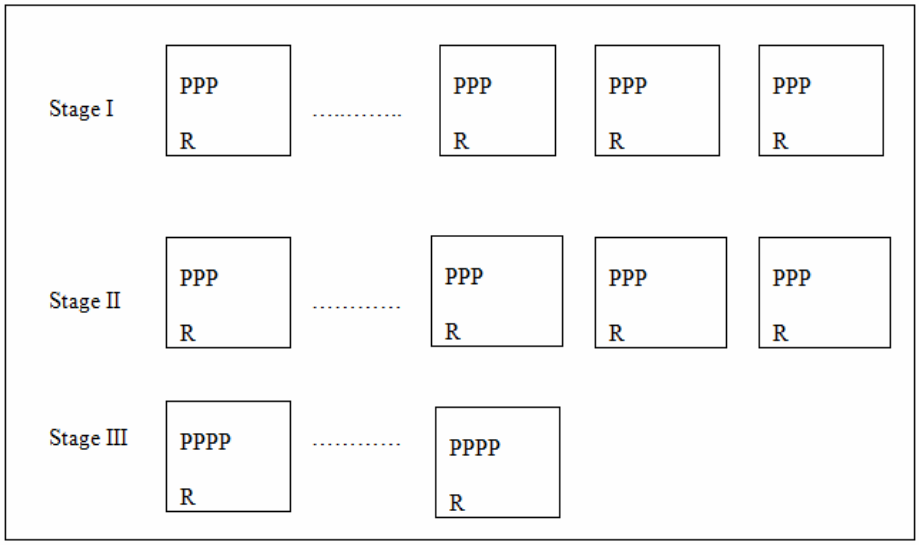

Fig. 1 Graphical scheme

I gave an example of a problem using the graphical method, the double ratio method which allows the achievement of the feedback mechanism on the three stages: the initial stage corresponding to the first ratio, the transformation stage and the final ratio stage.

Thus, the heuristic intuition allows that at the two levels: the conscious and the unconscious, we should achieve the division of pigeons and rabbits in groups both for the initial ratio and for the final ratio.

The psychological mechanism of feedback allows, in the continuation of conscious mind, in the case of stage I and stage III, which emphasize the initial ratio and final ratio, that the unconscious should intervene through the psychic automatism and that it should achieve the stage II, which allows the visualization of the transformations that occur for linking the two ratios.

In this sense, by selling two rabbits, two groups disappear and without the achievement of the stage II, the conscious would not have allowed the modality of visualization for the final stage.

The distribution of groups on the final ratio is accomplished by the subconscious through the transformation stage, where the four pigeons together with the six pigeons, existing in the odd groups, will be distributed one by one in each group in front.

So, each of the ten pigeons will complete a group which tells us that on the final ratio we have ten groups.

As two groups disappeared in the transformation stage, then in the initial stage we have 12 groups that will contain 1x 12 = 12 (rabbits) and 3 x 12 = 36 (pigeons).

The finding that the solution of the problem is correct can be achieved only by the conscious mind by revaluating the problem, by the required changes, and the conscious may establish that the final ratio is the given one.

Thus, the heuristic intuition, in the case of the double ratio problem, allows the resolution process by using the sequencing of the graphic scheme, making the transition to maturity and check of the way of visualization of the two ratios.

The existence of the transformation phase, which generates the problem solving process, connects the two ratios and anticipates the modalities of intervention for the heuristic intuition.

To highlight the accuracy of browsing the resolution process, it is necessary to examine the relationship between the problem data on the three stages and to complete the possible links to close the circuit.

In the case the of the examined problem, both the unconscious level and the conscious one are present at every stage and are interrelated to complete the feedback mechanism.

Conclusions

Using heuristic intuition allowed that the attention of the young pupil should move from the details of the action to its whole, where the unconscious intervenes in motor act control and marks the appearance of automatism in the execution sequence of the transformation stage.

The two plans of deploying the physical activity: the conscious and unconscious, through heuristic intuition intervene creatively in solving arithmetic problems, as a moment of building necessary mental representations and as an explorative structure related to the searching of the solution.

The modality of using the three stage graphical scheme allows the formation of some skills that help the resolution process in the context of solving arithmetic problems in primary school.

Therefore, the heuristic intuition involvement in solving arithmetic problems allows the understanding of the means by which one may find a viable mathematical solution and the presentation of the logic system which is constructed.

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